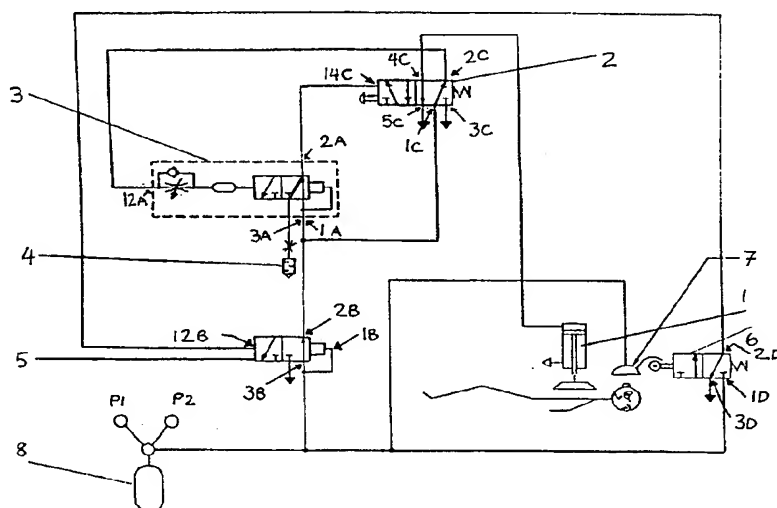


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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/NO94/00156 <b>(22) International Filing Date:</b> 22 September 1994 (22.09.94) <b>(30) Priority Data:</b> 933422 24 September 1993 (24.09.93) NO <b>(71)(72) Applicant and Inventor:</b> VISTUNG, Willy [NO/NO]; Kastanjeveien 5, N-0487 Oslo (NO). <b>(74) Agent:</b> HANSSEN, Kari, O.; Bryns Patentkontor A/S, P.O. Box 765, Sentrum, N-0106 Oslo (NO).		<b>(81) Designated States:</b> AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LT, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** MOBILE CARDIAC MASSAGE APPARATUS**(57) Abstract**

A mobile cardiac massage apparatus is described which comprises a pressure cylinder containing a medium suitable for supplying to a person with reduced or interrupted lung function, connected with a thrusting device for provision of cardiac compression. The apparatus comprises an automatic control device, which actuates cardiac compression, consisting of pressure regulated 3/2 valve open in the start phase, a time regulated valve closed in the start phase, a control link to determine the duration of the cardiac compression, and a unistable 5/2 valve, and having a breathing mask, there being a control means in operative connection with the automatic control device and the breathing mask.

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### MOBILE CARDIAC MASSAGE APPARATUS.

The present invention relates to a mobile apparatus for cardiac massage. More specifically, the present invention provides an apparatus for resuscitation of patients with cardiac arrest by means of cardiac compression combined with artificial ventilation.

Resuscitation as mentioned above is difficult to carry out correctly, partly because cardiac compression is physically very strenuous, and a person must be well practiced and experienced in order to execute it correctly. Further, it is difficult to coordinate the cardiac compressions with ventilation into the lungs at the correct tempo and with the necessary pause in the compressions. This type of resuscitation is difficult to carry out at a hospital under optimal conditions, very difficult outside a hospital and almost impossible in a moving ambulance and in rescue helicopters.

There has recently been developed an apparatus for automatic cardiac compression. In the event of a cardiac arrest, the patient is fastened securely to an equipment case by means of two shoulder straps and a plastic bar across the chest. On this bar is positioned a piston that receives energy pulses through a tube from a hydraulic unit inside the case. The hydraulic pump is driven by a battery.

Although this apparatus improves the potential for saving lives, it is nevertheless burdened with some critical disadvantages. First, the apparatus is dependent on electricity or battery power. Also, this solution provides for cardiac compression only.

In EP 0010908-A1 an apparatus for cardiac treatment is described. The apparatus discussed in this publication is far more complicated than the device according to the present invention and includes electrodes for electrical cardiac

stimulation. One of these electrodes is guided into the patient's oesophagus to the area under the heart, the other is placed on the surface of the compression device, which is pressed against the patient's chest. This is an apparatus which must be operated by trained personnel.

SE 7505469-2 relates to a device for ventilating a person, where the major emphasis is placed on the regulation of the piston stroke length and the oxygen volume that is introduced in accordance with the size of the patient.

US 1140581 describes a heart-lung resuscitation device that is pneumatically driven. It is apparent, however, that the control system used here is far more complicated, and thus more sensitive, than the control system of the present invention.

US 3307541 similarly describes an apparatus for cardiac treatment. This is also much more complicated than the device in accordance with the present invention. It includes, among other features, an air motor which drives some of the valves. The air motor is, in turn, driven by means of oxygen that is transferred from the oxygen container over into a smaller tank.

With the present invention there is provided an apparatus for a mobile heart massage unit comprising a pressure cylinder, containing a medium suitable for supplying to a person with reduced or interrupted lung function, connected with a thrust device for provision of cardiac compression, characterized in that it comprises an automatic control device which actuates the cardiac compression, consisting of a pressure regulated 3/2 valve that is open in the start phase, a time regulated valve that is closed in the start phase, a control link for determining the duration of the cardiac compression and a unistable 5/2 valve, and having a breathing mask, there being a control means in operative

connection with the automatic control device and the breathing mask.

The apparatus according to the invention may also be employed without the compression function, i.e., with supplying of oxygen only.

A preferred embodiment of the invention is characterized in that the control device is manual and consists of a switch which halts the cardiac compression simultaneously with the supplying of a respiratory medium to the injured person's lungs, and vice versa.

With the apparatus according to the invention, a number of advantages are attained compared with the primarily manual treatment used today:

- The apparatus provides for automatic cardiac compression with the aid of a pressure controlled piston having a compression pad that is placed over the heart region. The compression rate and pressure may be regulated as desired.
- On introduction of the respiratory medium into the patient's lungs, the cardiac compression stops automatically. When ventilation with the respiratory medium is completed, the cardiac compression automatically resumes at the same tempo. This function ensures that treatment will be correct and is a safeguard against faulty treatment.
- The ventilating mask [also referred to as a breathing mask] is equipped with a demand and by-pass function, whereby the patient on awakening automatically receives the amount of oxygen he requires. The by-pass valve is a safety valve that is released at a counterpressure of 45 cm water column.

- A significant advantage is that the apparatus is independent of external power sources and is driven by its own respiratory medium cylinder.

The apparatus is easy to use and is light-weight.

As respiratory medium, in connection with the apparatus according to the invention, there may be used media such as air, oxygen and/or "Entonox". The use of oxygen for ventilation also affords the advantage of enabling more effective oxygenation of the patient as compared with treatment with air. Entonox may be advantageous if it is an objective to relieve pain at the same time.

The ventilation can take place both with the aid of a breathing mask and by means of a tube.

The invention will be described in more detail in the following, with reference to the drawings, where:

Figure 1 is a schematic sketch of the apparatus according to the invention.

Figure 2 is a more detailed sketch indicating the control system for the apparatus according to the invention.

To use the apparatus, the patient is positioned in the apparatus such that the sternum is situated below cylinder 1. This is lowered down until it touches the breast bone. The part of the cylinder 1 that contacts the chest of the injured person may be designed in different ways. In one favorable embodiment it is designed as a suction cup. This provides a decompression which will promote the flow of oxygen and blood, since the chest will be slightly elevated. Pressure P2 is applied to the apparatus. The respiratory medium, preferably oxygen, will then pass through D1 gate 1B to 2B

(which is open) to the time regulated valve 3, gate 1A, which is closed, and to gate 1C of the unistable valve 2.

This directs the respiratory medium or oxygen out to gate 2C up to 12A on the time regulated valve 3. Timing commences. When the correct time is reached the valve is readjusted so that pressure exerted at gate 1A now goes out at gate 2a and proceeds on to gate 14c of the unistable valve 2.

This valve is then readjusted so that the pressure now moves from gate 1C and out at 4C, and into the cylinder which then exerts its thrust while the pressure at gate 12A of the time valve is discharged at gate 2C to gate 3C of the unistable valve 2.

The discharge of the control pressure at gate 14C of the unistable valve 2 begins, but will take some time through the throttling in outlet gate 3A in the time regulated valve 3. When this pressure has decreased to below 3.5 bar, the unistable valve 2 is switched over to the starting position again, and a new cycle begins. There are normally applied 60-65 thrusts per minute.

When the cylinder exerts its thrust, it applies about 40 mm of effective compression onto the chest due to suspension/-cushioning in the structure.

The ventilation of the patient is accomplished in the following manner:

A manual or automatic valve 6 is placed on the breathing mask, exerting pressure at gate 1D. Valve 6 is activated at the same time as the switch for release of the respiratory medium in the mask is activated. The pressure regulated valve 5 thereby acquires control pressure, and the connection between 1B and 2B is closed. The pulsing stops, the cylinder will return to position as its contents are discharged, and

the respiratory medium is simultaneously filled into the patient's lungs.

The consumption of respiratory medium is about 11 Nl/min. at a pressure of 6.3 bar, and at a rate of 60 thrusts/min.



P a t e n t   C l a i m s

1.

A mobile cardiac massage apparatus comprising a pressure cylinder (8), containing a medium suitable for supplying to a person with reduced or interrupted lung function, connected with a thrusting device (1) for provision of cardiac compression, c h a r a c t e r i z e d i n that it comprises an automatic control device which actuates cardiac compression, consisting of a pressure regulated 3/2 valve that is open in the start phase, a time regulated valve (3) that is closed in the start phase, a control link (4) for determining the duration of the cardiac compression and a unistable 5/2 valve (2), and having a breathing mask (7), there being a control means (6) in operative connection with the automatic control device and the breathing mask (7).

2.

An apparatus according to claim 1, c h a r a c t e r i z e d i n that the control means (6) is manual and consists of a switch which halts the cardiac compression simultaneously with the supplying of a respiratory medium to the injured person's lungs, and vice versa.

3.

An apparatus according to claims 1-2, c h a r a c t e r i z e d i n that the control means (6) operates automatically when the breathing mask (7) is placed on the patient.

4.

An apparatus according to claims 1-3, c h a r a c t e r i z e d i n that the control means (6) contains a demand valve and a by-pass valve.

1/2

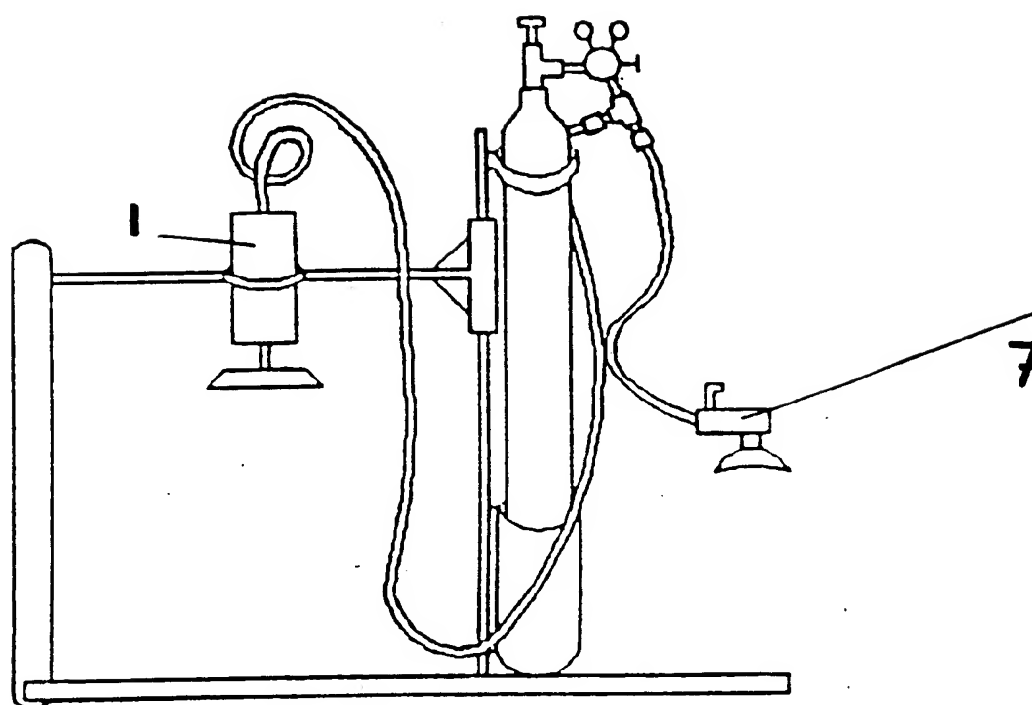
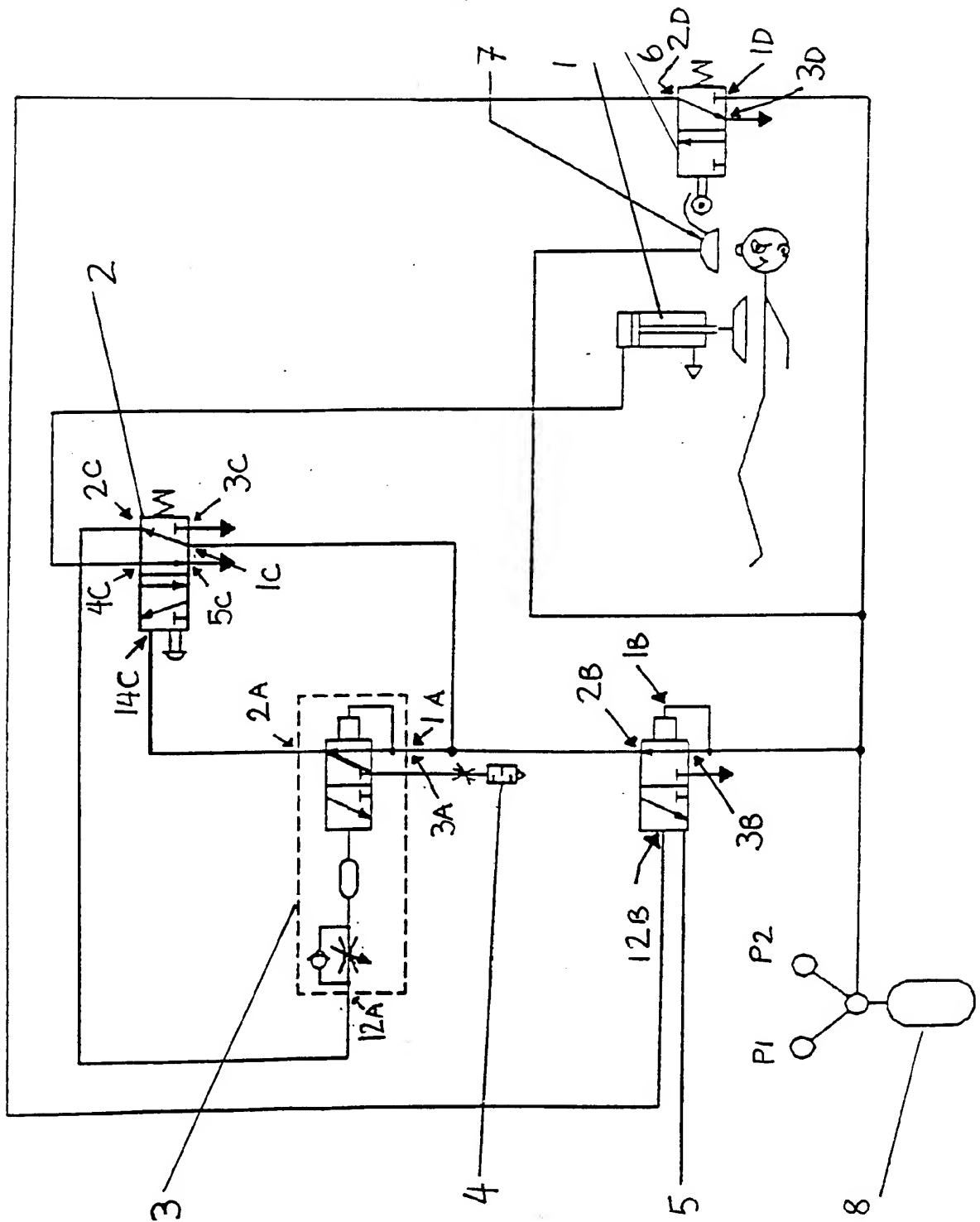


FIG. 1

2/2



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 94/00156

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A61H 31/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A61H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SE, B, 385542 (F RAGAILLER), 12 July 1976 (12.07.76), figure 1, claims 1-6 --	1-4
A	GB, A, 1140581 (CARL EDWIN HEWSON), 22 January 1969 (22.01.69), figures 1-2, claims 1-38 --	1-4
A	EP, A1, 0010908 (MICHIGAN INSTRUMENTS. INC.), 14 May 1980 (14.05.80), figure 6, claims 1-16 --	1-4

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Authorized officer

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 3307541 (C.E. HEWSON), 7 March 1967 (07.03.67), figure 2, claims 1-14  -- -----	1-4

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

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International application No.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE-B- 385542	12/07/76	NONE	
GB-A- 1140581	22/01/69	NONE	
EP-A1- 0010908	14/05/80	AT-T- 2930	15/04/83
		CA-A- 1133586	12/10/82
		JP-C- 1369400	25/03/87
		JP-A- 55054965	22/04/80
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		US-A- 4273114	16/06/81
US-A- 3307541	07/03/67	NONE	